

## UNDERSTANDING WIND CHILL

As the weather becomes "frightful" during winter months, workers who must brave outdoor conditions face the occupational hazard of exposure to the cold. Prolonged exposure to freezing temperatures can result in health problems as serious as trench foot, frostbite, and hypothermia.

Workers in such industries as public works, sanitation, recreation, and agriculture need to be especially mindful of the weather, its effects on the body, proper prevention techniques, and treatment of cold-related disorders.

### The cold environment

An individual gains body heat from food and muscular activity, and loses it through convection, conduction, radiation, and sweating to maintain a constant body temperature. When body temperature drops even a few degrees below its normal temperature of 98.6°F (37°C), the blood vessels constrict, decreasing peripheral blood flow to reduce heat loss from the surface of the skin. Shivering generates heat by increasing the body's metabolic rate.

The four environmental conditions that cause cold-related stress are low temperatures, high/cool winds, dampness, and cold water.

Wind chill, a combination of temperature and velocity, is a crucial factor to evaluate when working outside. For example, when the actual air temperature of the wind is 40°F and its velocity is 35 mph, the exposed skin receives conditions equivalent to the still-air temperature being 28°F. A dangerous situation of rapid heat loss may arise for any individual exposed to high winds and cold temperatures.



### Wind Chill Chart



Temperature (°F)

Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times

30 minutes

10 minutes

5 minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75(V<sup>0.16</sup>) + 0.4275T(V<sup>0.16</sup>)

Where, T= Air Temperature (°F)

V= Wind Speed (mph)

Effective 11/01/01

The Wind Chill Chart at left shows the difference between actual air temperature and perceived temperature, and amount of time until frostbite occurs.

Wind Chill Advisories are issued by the National Weather Service (NWS) when the wind chill is expected to drop to between -10°F and -24°F. When the wind chill is expected to drop below -24°F a Wind Chill Warning will be issued.

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## Major risk factors for cold-related stresses

- Wearing inadequate or wet clothing increases the effects of cold on the body.
- Taking certain drugs or medications such as alcohol, nicotine, caffeine, and medication which inhibits the body's response to the cold or impairs judgment.
- Being sick with the common cold or certain diseases, such as diabetes, heart, vascular, and thyroid problems, may make a person more susceptible to the winter elements.
- Being male increases a person's risk of cold-related stresses. Sad, but true, men experience far greater death rates due to cold exposure than women, perhaps due to inherent risk-taking activities, body-fat composition, or other physiological differences.
- Becoming exhausted or immobilized, especially due to injury or entrapment, may speed up the effects of cold weather.
- Aging – the elderly are more vulnerable to the effects of harsh winter weather.

## Harmful effects of cold

**Trench Foot** is caused by long, continuous exposure to a wet, cold environment or actual immersion in water. Individuals working in continuously wet conditions, who experience these types of cold, wet environments daily, need to be especially cautious.

**Symptoms:** Symptoms include a tingling and/or itching sensation, burning, pain, and swelling, sometimes forming blisters in more extreme cases.

**Treatment:** Move individuals with trench foot to a warm, dry area, where the affected tissue can be treated with careful washing and drying, re-warming, and slight elevation. Seek medical assistance as soon as possible.

**Frostbite** occurs when the skin tissue freezes, causing ice crystals to form between cells and draw water from them, which leads to cellular dehydration. Although this typically occurs at temperatures below 30° F (-1° C), wind chill effects can cause frostbite at above-freezing temperatures.

**Symptoms:** Initial effects of frostbite include uncomfortable sensations of coldness; tingling, stinging or aching feeling of the exposed area followed by numbness. Ears, fingers, toes, cheeks, and noses are primarily affected. Frostbitten areas appear white and cold to the touch. The appearance of frostbite varies depending on whether re-warming has occurred.

Deeper frostbite involves the freezing of deeper tissues (muscles, tendons, etc.) causing exposed areas to become numb, painless, and hard to the touch.

**Treatment:** If you suspect frostbite, you should seek medical assistance immediately. Any existing hypothermia should be treated first (see hypothermia below). Frostbitten parts should be covered with dry, sterile gauze or soft, clean cloth bandages.

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Do not massage frostbitten tissue because this sometimes causes greater injury. Severe cases may require hospitalization and even amputation of the affected tissue. Take measures to prevent further cold injury. If formal medical treatment will be delayed, consult with a licensed health care professional for training on re-warming techniques.

**General hypothermia** occurs when body temperature falls to a level where normal muscular and cerebral functions are impaired. While hypothermia is generally associated with freezing temperatures, it may occur in any climate where a person's body temperature falls below normal. For instance, hypothermia is common among the elderly who live in cold houses.

**Symptoms:** The first symptoms of hypothermia, shivering, an inability to do complex motor functions, lethargy, and mild confusion, occur as the core body temperature decreases to around 95° F (35° C).

As body temperature continues to fall, hypothermia becomes more severe. The individual falls into a state of dazed consciousness, failing to complete even simple motor functions. The victim's speech becomes slurred and his or her behavior may become irrational.

The most severe state of hypothermia occurs when body temperature falls below 90° F (32° C). As a result, the body moves into a state of hibernation, slowing the heart rate, blood flow, and breathing. Unconsciousness and full heart failure can occur in a severely hypothermic state.

**Treatment:** Treatment of hypothermia involves conserving the victim's remaining body heat and providing additional heat sources. Specific measures will vary depending on the severity and setting (field or hospital). Handle hypothermic people carefully because of the increased irritability of a cold heart. Seek medical assistance for persons suspected of being moderately or severely hypothermic.

If the person is unresponsive and not shivering, assume he or she is suffering from severe hypothermia. Reduction of heat loss can be accomplished by various means: obtaining shelter, removal of wet clothing, adding layers of dry clothing, blankets, or using a pre-warmed sleeping bag.

For mildly hypothermic cases or those more severe cases where medical treatment will be significantly delayed, external re-warming techniques may be applied. This includes body-to-body contact (e.g., placing the person in a pre-warmed sleeping bag with a person of normal body temperature), chemical heat packs, or insulated hot water bottles. Good areas to place these packs are the armpits, neck, chest, and groin. It is best to have the person lying down when applying external re-warming. You also may give mildly hypothermic people warm fluids orally, but avoid beverages containing alcohol or caffeine.

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## Preventing cold-related disorders

Personal protective clothing is perhaps the most important step in fighting the elements – by providing adequate layers of insulation from them. Wear at least three layers of clothing:

- An outer layer to break the wind and allow some ventilation (like Gore-Tex® or nylon);
- A middle layer of wool or synthetic fabric (Qualofil or Pile) to absorb sweat and retain insulation in a damp environment. Down is a useful lightweight insulator; however, it is ineffective once it becomes wet.
- An inner layer of cotton or synthetic weave to allow ventilation.

Pay special attention to protecting feet, hands, face, and head. Up to 40 percent of body heat can be lost when the head is exposed. Footgear should be insulated to protect against cold and dampness. Keep a change of clothing available in case work garments become wet.

Engineering controls in the workplace through a variety of practices help reduce the risk of cold-related injuries.

- Use an on-site source of heat, such as air jets, radiant heaters, or contact warm plates.
- Shield work areas from drafty or windy conditions.
- Provide a heated shelter for employees who experience prolonged exposure to equivalent wind-chill temperatures of 20 °F (-6 °C) or less.
- Use thermal insulating material on equipment handles when temperatures drop below 30 °F (-1 °C).

Safe work practices, such as changes in work schedules are necessary to combat the effects of exceedingly cold weather.

- Allow a period of adjustment to the cold before embarking on a full work schedule.
- Always permit employees to set their own pace and take extra work breaks when needed.
- Reduce, as much as possible, the number of activities performed outdoors. When employees must brave the cold, select the warmest hours of the day and minimize activities that reduce circulation.
- Ensure that employees remain hydrated.
- Establish a buddy system for working outdoors.
- Educate employees to the symptoms of cold-related stresses – heavy shivering, uncomfortable coldness, severe fatigue, drowsiness, or euphoria.

The quiet symptoms of potentially deadly cold-related ailments often go undetected until the victim's health is endangered. Knowing the facts on cold exposure and following a few simple guidelines can ensure that this season is a safe and healthy one.